6.9.4

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

IN REPLY
REFER TO: OEA-095 November 24, 1999

MEMORANDUM

SUBJECT: Bunker Hill, CLP Metals Analysis, Data Validation
Case: 27338
SDG: MJAK77

FROM: Laura Castrilli, Chemist
Quality Assurance and Data Unit, OEA

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1125019

TO: Mary Kay Voytilla, Regional Project Manager
Office of Environmental Cleanup

CC: Bruce Woods, Region 10 CLP TPO
Jim Stefanoff, CH2M Hill

The following is a validation of ICP-AES and mercury analyses of fifteen total and five dissolved water samples from the Bunker Hill project. The analyses were performed following the USEPA Contract Laboratory Program Statement of Work for Inorganics Analysis Multi-media, Multi-Concentration, ILM04.0. Analyses were conducted by Sentinel, Inc, of Huntsville, Alabama. This validation was conducted for the following samples:

MJAK77	MJAK80	MJAK83	MJAK86	MJAK89	MJAK92	MJAK95
MJAK78	MJAK81	MJAK84	MJAK87	MJAK90	MJAK93	MJAK96
MJAK79	MJAK82	MJAK85	MJAK88	MJAK91	MJAK94	

Data Qualifications

The following comments refer to the Sentinel Laboratory's performance in meeting quality control specifications outlined in the *CLP Statement of Work (CLP-SOW) for Inorganic Analysis, rev. ILM04.0.* The comments presented herein are based on the information provided for the review.

1.0 Timeliness -

The technical (40 CFR part 136) holding time from the date of collection for mercury in water is 28 days. The holding time for the remaining metals in water is 180 days. The samples were collected on 08/26/99 and 9/10/99. Mercury analyses were completed on 09/24/99, one day outside the holding time for the samples collected on August 26. ICP-AES analyses were completed on 09/27/99. Since the holding

time for mercury was only missed by one day, no qualification was made on this basis.

2.0 Sample Preparation - Acceptable

The samples were prepared for mercury analyses on 09/23/99. The samples were prepared for ICP-AES analyses on 09/22/99. No qualification was made based on sample preparation.

3.0 Calibrations/Calibration Verifications -

The samples were analyzed for mercury by CVAAS on 09/24/99. Initial calibration included one blank and six standards. The curve was linear with a correlation coefficient greater than 0.995.

The samples were analyzed by ICP-AES on 09/23/99 (main analyses), 09/24/99 (iron, manganese and/or zinc dilutions), and 09/27/99 (further zinc dilutions). The instrument was standardized according to the analytical method each day of analysis using one blank and a single calibration standard for each element.

All ICP-AES and CVAAS (mercury) calibrations were performed as required and met the acceptance criteria; therefore, no qualification was made on this basis.

Continuing calibration verifications (CCVs) are required before and after sample analysis and after every 10 samples during analysis. Mercury recoveries must be within 80-120%. Other metal recoveries must be within 90-110%. The frequency of analysis of CCVs was met. All ICP-AES and CVAAS (mercury) CCVs (initial and continuing) bracketing reported sample results met the recovery criteria; with the exception of the fourth CCV during the main analyses on 09/23/99. The recovery for zinc was 116%. The calibration blank ran immediately after this verification showed evidence of carry over for zinc. A couple of samples ran before the CCV had levels of zinc requiring 100 fold dilutions (with one sample requiring a 1000 fold dilution). The reported zinc data for samples ran before and after this CCV were examined for evidence of carry over (i.e. high bias). Based on this examination, zinc in sample MJAK90 was qualified 'J', estimated (possible high bias).

All of the remaining reported zinc results were all considerably higher than the estimated carry over and therefore, were not qualified on this basis.

4.0 Laboratory Control Samples - Acceptable

Laboratory Control samples are digested and analyzed along with the samples to verify the efficiency of laboratory procedures. All recoveries associated with reported sample results met the acceptance criteria; therefore no qualification was made on this basis.

5.0 Blanks -

Procedural blanks were prepared with the samples to show potential contamination from the digestion or analytical procedure. If an analyte was found in the associated blank, the sample results were qualified if the analyte concentration was less than five times the analytical value in the blank.

Aluminum, barium, calcium, iron, and magnesium in the preparation blank had negative results with absolute values greater than the detection limits. Aluminum, calcium, iron, magnesium, manganese, sodium, and zinc were detected in one or more continuing calibration blanks (CCBs). Aluminum, calcium, and magnesium in one or more CCBs had negative results with absolute values greater than the detection limits. Based on blank contamination, associated sample results were qualified as follows:

- aluminum in samples MJAK77, MJAK81, MJAK82, MJAK86, and MJAK92 was qualified 'J'
- barium in sample MJAK94 was qualified 'J'
- sodium in sample MJAK90 was qualified 'U'

All other sample results were greater than five times the associated blank levels (or were already undetected) and were not qualified based on blank contamination.

6.0 ICP-AES Interference Check Sample -

The interference check sample (ICS) is analyzed by ICP-AES to verify interelement and background correction factors. Analysis is required at the beginning and end of each sample analysis run and recoveries must be between 80% and 120%. All ICS recoveries associated with reported sample results were within the recovery criterion; with the exception of the copper recovery (78% recovery, true value = 28 ug/L) in two of the three ICS-A analyses on 9/23/99. The ICS-AB recoveries for copper were all acceptable (true value = 507 ug/L). One copper result (sample MJAK96) was qualified 'UJ' (possible false negative) based on the ICS-A recovery. The remaining copper sample results were at levels closer to or greater than the ICS-AB copper level, and were not qualified on this basis.

The raw data for a number of samples had interfering levels of iron and/or manganese. Analytes for which iron and/or manganese is an interferent were qualified as follows:

- Aluminum in sample MJAK96 was qualified 'J', estimated (possible high bias due to high manganese). Analyte equivalents in Table 2 of ILM04.0 were used to estimated the interference with aluminum due to manganese at levels > 45 mg/L.

- Chromium in samples MJAK78, MJAK80, MJAK83, MJAK85, MJAK87, MJAK89, MJAK91, MJAK94, MJAK95, and MJAK96 was qualified 'UJ',

estimated detection limit (possible false positives due to high manganese). Analyte equivalents in Table 2 of ILM04.0 were used to estimated the interference with chromium due to manganese at levels > 45 mg/L.

- Vanadium in samples MJAK78, MJAK80, MJAK83, MJAK85, MJAK87, MJAK88, MJAK89, MJAK91, MJAK94, MJAK95, and MJAK96 was qualified 'UJ', estimated detection limit (possible false negatives due to high iron). Vanadium in all three of the ICS-A analyses bracketing these samples had negative results with absolute values greater than the detection limit.

Some of the samples required one or more dilution runs to report iron, zinc, and/or manganese results within the instrumental linear range. The raw data for all analytes were compared using the available dilutions to see if 1) zinc and/or manganese levels in the undiluted samples were high enough that interelement corrections may not be sufficient for the analytes that were reported from the undiluted analysis or 2) a pattern of suppression or enhancement was evident.

This review was limited to an assessment of just cadmium, iron, manganese, lead, and zinc results. Based on this assessment, cadmium, manganese, and lead in sample MJAK88 were qualified 'J' (evidence of suppression) and cadmium in sample MJAK96 was qualified 'J' (evidence of suppression).

7.0 Duplicate Analysis - Acceptable

Duplicate analyses were done on sample MJAK77. Water duplicate results were within the ±20% Relative Percent Difference (RPD) or ±CRDL criteria for water results < 5 times the CRDL criteria. No qualification was made based on duplicate results.

8.0 Field Duplicate Analysis - Not Applicable

Field duplicate analysis for samples in this SDG was not indicated in the field collection documentation.

9.0 Matrix Spike Analysis -

Matrix spike sample analyses are done to provide information about the effect of the sample matrix on digestion and measurement methods. Matrix spike recovery must be within the limits of 75 - 125%.

Matrix spike analyses were done on sample MJAK77. All matrix spike recoveries were within the required QC limits, with the exception of antimony (62%). All antimony results were qualified 'J', estimated (possible low bias).

10.0 Graphite Furnace Atomic Absorption Spec (GFAAS) QC - Not Applicable - GFAAS was not used for the analysis of these samples.

11.0 ICP-AES Serial Dilution -

Sample MJAK77 was analyzed by ICP-AES serial dilution to check for potential interferences. All analytes which exceeded the minimum concentration criterion (50 times the IDL) agreed within the 10%D criteria; with the exception of potassium (12.5%). All potassium results were qualified 'J', estimated.

12.0 Detection Limits - Acceptable

Sample results which fall below the instrument detection limit (IDL) are assigned the value of the instrument detection limit and the 'U' qualifier is attached. Contract Required Detection Limit (CRDL) standards are required to demonstrate a linear calibration curve near the CRDL. CRDL standards were run at the required frequency.

13.0 Overall Assessment of the Data

This validation of the data is based on the criteria outlined in the *National Functional Guidelines for Inorganic Data Review (02/94)*. Approximately 17% of the data was qualified based on blank contamination, carry over, interference, serial dilution results or matrix spike recovery.

Below are the definitions for the National Functional Guidelines for Inorganic Data Review (02/94) qualifiers used when validating/qualifying data from Inorganic analysis.

DATA QUALIFIERS

U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

J - The associated value is an estimated quantity.

R - The data are unusable. (Note: Analyte may or may not be present.)

UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAK77

Lab Name: SENTINEL INC. Contract: 68-D6-0001

Lab Code: SENTIN Case No.: 27338 SAS No.: SDG No.: MJAK77

Matrix (soil/water): WATER Lab Sample ID: 24193S

Level (low/med): LOW Date Received: 08/27/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	183	B	J	P
7440-36-0	Antimony	3.0	U	~~N~~ J	P
7440-38-2	Arsenic	64.9			P
7440-39-3	Barium	16.4	B		P
7440-41-7	Beryllium	0.40	U		P
7440-43-9	Cadmium	37.1			P
7440-70-2	Calcium	7800			P
7440-47-3	Chromium	1.0	U		P
7440-48-4	Cobalt	15.3	B		P
7440-50-8	Copper	40.4			P
7439-89-6	Iron	31100			P
7439-92-1	Lead	767			P
7439-95-4	Magnesium	4620	B		P
7439-96-5	Manganese	5920			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	13.3	B		P
7440-09-7	Potassium	1420	B	~~B~~ J	P
7782-49-2	Selenium	2.3	U		P
7440-22-4	Silver	2.8	B		P
7440-23-5	Sodium	1250	B		P
7440-28-0	Thallium	11.5			P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	14400			P
	Cyanide				NR

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INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MJAK78

Lab Name: SENTINEL INC. Contract: 68-D6-0001

Lab Code: SENTIN Case No.: 27338 SAS No.: SDG No.: MJAK77

Matrix (soil/water): WATER Lab Sample ID: 24194S

Level (low/med): LOW Date Received: 08/27/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	9190			P
7440-36-0	Antimony	8.3	B	~~N~~ J	P
7440-38-2	Arsenic	526			P
7440-39-3	Barium	8.3	B		P
7440-41-7	Beryllium	5.5			P
7440-43-9	Cadmium	907			P
7440-70-2	Calcium	32600			P
7440-47-3	Chromium	4.9	~~B~~	UJ	P
7440-48-4	Cobalt	125			P
7440-50-8	Copper	298			P
7439-89-6	Iron	606000			P
7439-92-1	Lead	904			P
7439-95-4	Magnesium	80100			P
7439-96-5	Manganese	91400			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	128			P
7440-09-7	Potassium	749	B	~~E~~ J	P
7782-49-2	Selenium	61.2			P
7440-22-4	Silver	35.9			P
7440-23-5	Sodium	28800			P
7440-28-0	Thallium	143			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	442000			P
	Cyanide				NR

9/28/99

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EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAK79

Lab Name: SENTINEL INC. Contract: 68-D6-0001

Lab Code: SENTIN Case No.: 27338 SAS No.: SDG No.: MJAK77

Matrix (soil/water): WATER Lab Sample ID: 24195S

Level (low/med): LOW Date Received: 08/27/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	388			P
7440-36-0	Antimony	3.0	U	~~N~~ J	P
7440-38-2	Arsenic	19.3			P
7440-39-3	Barium	22.4	B		P
7440-41-7	Beryllium	0.40	U		P
7440-43-9	Cadmium	18.1			P
7440-70-2	Calcium	6780			P
7440-47-3	Chromium	1.0	U		P
7440-48-4	Cobalt	3.7	B		P
7440-50-8	Copper	22.7	B		P
7439-89-6	Iron	7900			P
7439-92-1	Lead	188			P
7439-95-4	Magnesium	6060			P
7439-96-5	Manganese	4120			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	5.0	B		P
7440-09-7	Potassium	708	B	~~E~~ J	P
7782-49-2	Selenium	2.3	U		P
7440-22-4	Silver	1.4	U		P
7440-23-5	Sodium	890	B		P
7440-28-0	Thallium	3.3	U		P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	6650			P
	Cyanide				NR

9/22/11/23/99

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INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MJAK80

Lab Name: SENTINEL INC. Contract: 68-D6-0001

Lab Code: SENTIN Case No.: 27338 SAS No.: SDG No.: MJAK77

Matrix (soil/water): WATER Lab Sample ID: 24196S

Level (low/med): LOW Date Received: 08/27/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	21000			P
7440-36-0	Antimony	20.6	B	~~N~~ J	P
7440-38-2	Arsenic	1230			P
7440-39-3	Barium	6.6	B		P
7440-41-7	Beryllium	12.2			P
7440-43-9	Cadmium	1940			P
7440-70-2	Calcium	53400			P
7440-47-3	Chromium	10.0		UJ	P
7440-48-4	Cobalt	271			P
7440-50-8	Copper	687			P
7439-89-6	Iron	1520000			P
7439-92-1	Lead	1030			P
7439-95-4	Magnesium	114000			P
7439-96-5	Manganese	215000			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	271			P
7440-09-7	Potassium	628	B	~~E~~ J	P
7782-49-2	Selenium	140			P
7440-22-4	Silver	69.9			P
7440-23-5	Sodium	82500			P
7440-28-0	Thallium	331			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	1080000			P
	Cyanide				NR

11/23/99

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Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAK81

Lab Name: SENTINEL INC. Contract: 68-D6-0001

Lab Code: SENTIN Case No.: 27338 SAS No.: SDG No.: MJAK77

Matrix (soil/water): WATER Lab Sample ID: 24197S

Level (low/med): LOW Date Received: 08/27/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	154	B	J	P
7440-36-0	Antimony	3.0	U	~~N~~ J	P
7440-38-2	Arsenic	50.1			P
7440-39-3	Barium	15.4	B		P
7440-41-7	Beryllium	0.40	U		P
7440-43-9	Cadmium	33.8			P
7440-70-2	Calcium	7410			P
7440-47-3	Chromium	1.0	U		P
7440-48-4	Cobalt	13.8	B		P
7440-50-8	Copper	33.6			P
7439-89-6	Iron	28200			P
7439-92-1	Lead	676			P
7439-95-4	Magnesium	4450	B		P
7439-96-5	Manganese	5680			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	13.0	B		P
7440-09-7	Potassium	1330	B	~~E~~ J	P
7782-49-2	Selenium	2.3	U		P
7440-22-4	Silver	2.1	B		P
7440-23-5	Sodium	1110	B		P
7440-28-0	Thallium	6.3	B		P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	13600			P
_____	Cyanide				NR

12/23/99

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INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MJAK82

Lab Name: SENTINEL INC. Contract: 68-D6-0001

Lab Code: SENTIN Case No.: 27338 SAS No.: SDG No.: MJAK77

Matrix (soil/water): WATER Lab Sample ID: 24198S

Level (low/med): LOW Date Received: 08/27/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	142	B	J	P
7440-36-0	Antimony	3.0	U	~~N~~J	P
7440-38-2	Arsenic	3.0	U		P
7440-39-3	Barium	16.0	B		P
7440-41-7	Beryllium	0.40	U		P
7440-43-9	Cadmium	25.9			P
7440-70-2	Calcium	7770			P
7440-47-3	Chromium	1.0	U		P
7440-48-4	Cobalt	14.1	B		P
7440-50-8	Copper	21.9	B		P
7439-89-6	Iron	18700			P
7439-92-1	Lead	640			P
7439-95-4	Magnesium	4460	B		P
7439-96-5	Manganese	5710			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	13.1	B		P
7440-09-7	Potassium	1390	B	~~B~~J	P
7782-49-2	Selenium	2.3	U		P
7440-22-4	Silver	1.8	B		P
7440-23-5	Sodium	1160	B		P
7440-28-0	Thallium	5.9	B		P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	12300			P
	Cyanide				NR

11/23/99

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Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAK83

Lab Name: SENTINEL INC. Contract: 68-D6-0001

Lab Code: SENTIN Case No.: 27338 SAS No.: SDG No.: MJAK77

Matrix (soil/water): WATER Lab Sample ID: 24199S

Level (low/med): LOW Date Received: 08/27/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	9450			P
7440-36-0	Antimony	7.2	B	~~N~~J	P
7440-38-2	Arsenic	539			P
7440-39-3	Barium	7.5	B		P
7440-41-7	Beryllium	5.5			P
7440-43-9	Cadmium	929			P
7440-70-2	Calcium	33300			P
7440-47-3	Chromium	5.2	~~B~~	UJ	P
7440-48-4	Cobalt	129			P
7440-50-8	Copper	306			P
7439-89-6	Iron	610000			P
7439-92-1	Lead	926			P
7439-95-4	Magnesium	82300			P
7439-96-5	Manganese	92200			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	131			P
7440-09-7	Potassium	769	B	~~E~~J	P
7782-49-2	Selenium	60.3			P
7440-22-4	Silver	34.5			P
7440-23-5	Sodium	30100			P
7440-28-0	Thallium	141			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	450000			P
	Cyanide				NR

DC 11/23/99

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EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAK84

Lab Name: SENTINEL INC. Contract: 68-D6-0001

Lab Code: SENTIN Case No.: 27338 SAS No.: SDG No.: MJAK77

Matrix (soil/water): WATER Lab Sample ID: 24200S

Level (low/med): LOW Date Received: 08/27/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	353			P
7440-36-0	Antimony	3.0	U	~~N~~ J	P
7440-38-2	Arsenic	10.3			P
7440-39-3	Barium	23.3	B		P
7440-41-7	Beryllium	0.40	U		P
7440-43-9	Cadmium	18.9			P
7440-70-2	Calcium	7100			P
7440-47-3	Chromium	1.0	U		P
7440-48-4	Cobalt	3.9	B		P
7440-50-8	Copper	23.4	B		P
7439-89-6	Iron	5800			P
7439-92-1	Lead	177			P
7439-95-4	Magnesium	6330			P
7439-96-5	Manganese	4280			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	5.4	B		P
7440-09-7	Potassium	739	B	~~E~~ J	P
7782-49-2	Selenium	2.3	U		P
7440-22-4	Silver	1.4	U		P
7440-23-5	Sodium	962	B		P
7440-28-0	Thallium	3.3	U		P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	6930			P
_____	Cyanide				NR

11/23/99

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Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAK85

Lab Name: SENTINEL INC. Contract: 68-D6-0001

Lab Code: SENTIN Case No.: 27338 SAS No.: SDG No.: MJAK77

Matrix (soil/water): WATER Lab Sample ID: 24201S

Level (low/med): LOW Date Received: 08/27/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	21000			P
7440-36-0	Antimony	21.6	B	~~N~~ J	P
7440-38-2	Arsenic	1220			P
7440-39-3	Barium	8.2	B		P
7440-41-7	Beryllium	12.0			P
7440-43-9	Cadmium	1940			P
7440-70-2	Calcium	53800			P
7440-47-3	Chromium	10.1		UJ	P
7440-48-4	Cobalt	270			P
7440-50-8	Copper	687			P
7439-89-6	Iron	1480000			P
7439-92-1	Lead	1030			P
7439-95-4	Magnesium	114000			P
7439-96-5	Manganese	210000			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	271			P
7440-09-7	Potassium	656	B	~~E~~ J	P
7782-49-2	Selenium	133			P
7440-22-4	Silver	68.0			P
7440-23-5	Sodium	83300			P
7440-28-0	Thallium	324			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	1050000			P
	Cyanide				NR

11/23/99

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MJAK86

Lab Name: SENTINEL INC. Contract: 68-D6-0001

Lab Code: SENTIN Case No.: 27338 SAS No.: SDG No.: MJAK77

Matrix (soil/water): WATER Lab Sample ID: 24202S

Level (low/med): LOW Date Received: 08/27/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	194	B	J	P
7440-36-0	Antimony	3.0	U	~~N~~J	P
7440-38-2	Arsenic	12.6			P
7440-39-3	Barium	16.6	B		P
7440-41-7	Beryllium	0.40	U		P
7440-43-9	Cadmium	35.7			P
7440-70-2	Calcium	7960			P
7440-47-3	Chromium	1.0	U		P
7440-48-4	Cobalt	14.6	B		P
7440-50-8	Copper	37.8			P
7439-89-6	Iron	26300			P
7439-92-1	Lead	646			P
7439-95-4	Magnesium	4710	B		P
7439-96-5	Manganese	5940			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	14.0	B		P
7440-09-7	Potassium	1430	B	~~E~~J	P
7782-49-2	Selenium	4.0	B		P
7440-22-4	Silver	1.9	B		P
7440-23-5	Sodium	1260	B		P
7440-28-0	Thallium	7.8	B		P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	14100			P
	Cyanide				NR

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAK87

Lab Name: SENTINEL INC. Contract: 68-D6-0001

Lab Code: SENTIN Case No.: 27338 SAS No.: SDG No.: MJAK77

Matrix (soil/water): WATER Lab Sample ID: 24772S

Level (low/med): LOW Date Received: 09/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	9580			P
7440-36-0	Antimony	3.7	B	~~N~~ J	P
7440-38-2	Arsenic	322			P
7440-39-3	Barium	10.7	B		P
7440-41-7	Beryllium	3.1	B		P
7440-43-9	Cadmium	585			P
7440-70-2	Calcium	35500			P
7440-47-3	Chromium	2.4	~~B~~	UJ	P
7440-48-4	Cobalt	190			P
7440-50-8	Copper	569			P
7439-89-6	Iron	280000			P
7439-92-1	Lead	373			P
7439-95-4	Magnesium	64800			P
7439-96-5	Manganese	63600			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	163			P
7440-09-7	Potassium	1060	B	~~E~~ J	P
7782-49-2	Selenium	29.6			P
7440-22-4	Silver	20.0			P
7440-23-5	Sodium	16900			P
7440-28-0	Thallium	67.4			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	292000			P
	Cyanide				NR

11/23/99

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAK88

Lab Name: SENTINEL INC. Contract: 68-D6-0001

Lab Code: SENTIN Case No.: 27338 SAS No.: SDG No.: MJAK77

Matrix (soil/water): WATER Lab Sample ID: 24773S

Level (low/med): LOW Date Received: 09/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	189000			P
7440-36-0	Antimony	166		~~N~~ J	P
7440-38-2	Arsenic	8600			P
7440-39-3	Barium	15.7	B		P
7440-41-7	Beryllium	35.2			P
7440-43-9	Cadmium	9470		J	P
7440-70-2	Calcium	134000			P
7440-47-3	Chromium	33.0			P
7440-48-4	Cobalt	2760			P
7440-50-8	Copper	10700			P
7439-89-6	Iron	11500000			P
7439-92-1	Lead	679		J	P
7439-95-4	Magnesium	382000			P
7439-96-5	Manganese	30300		J	P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	2180			P
7440-09-7	Potassium	146	B	~~E~~ J	P
7782-49-2	Selenium	44.3			P
7440-22-4	Silver	1.4	U		P
7440-23-5	Sodium	701000			P
7440-28-0	Thallium	799			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	16800000			P
	Cyanide				NR

11/23/99

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAK89

Lab Name: SENTINEL INC. Contract: 68-D6-0001

Lab Code: SENTIN Case No.: 27338 SAS No.: SDG No.: MJAK77

Matrix (soil/water): WATER Lab Sample ID: 24774S

Level (low/med): LOW Date Received: 09/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	40700			P
7440-36-0	Antimony	30.4	B	~~N~~ J	P
7440-38-2	Arsenic	1120			P
7440-39-3	Barium	5.3	B		P
7440-41-7	Beryllium	9.1			P
7440-43-9	Cadmium	2040			P
7440-70-2	Calcium	45300			P
7440-47-3	Chromium	11.7		UJ	P
7440-48-4	Cobalt	611			P
7440-50-8	Copper	2560			P
7439-89-6	Iron	1190000			P
7439-92-1	Lead	705			P
7439-95-4	Magnesium	134000			P
7439-96-5	Manganese	212000			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	458			P
7440-09-7	Potassium	742	B	~~E~~ J	P
7782-49-2	Selenium	112			P
7440-22-4	Silver	59.1			P
7440-23-5	Sodium	84200			P
7440-28-0	Thallium	267			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	1070000			P
	Cyanide				NR

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MJAK90

Lab Name: SENTINEL INC. Contract: 68-D6-0001

Lab Code: SENTIN Case No.: 27338 SAS No.: SDG No.: MJAK77

Matrix (soil/water): WATER Lab Sample ID: 24775S

Level (low/med): LOW Date Received: 09/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	665			P
7440-36-0	Antimony	3.0	U	~~N~~ J	P
7440-38-2	Arsenic	31.5			P
7440-39-3	Barium	4.7	B		P
7440-41-7	Beryllium	0.40	U		P
7440-43-9	Cadmium	4.3	B		P
7440-70-2	Calcium	3820	B		P
7440-47-3	Chromium	1.0	U		P
7440-48-4	Cobalt	10.1	B		P
7440-50-8	Copper	4.2	B		P
7439-89-6	Iron	19800			P
7439-92-1	Lead	31.4			P
7439-95-4	Magnesium	1980	B		P
7439-96-5	Manganese	2420			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	6.1	B		P
7440-09-7	Potassium	806	B	~~E~~ J	P
7782-49-2	Selenium	2.3	U		P
7440-22-4	Silver	1.4	U		P
7440-23-5	Sodium	735	~~B~~ U		P
7440-28-0	Thallium	4.7	B		P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	2350		J	P
	Cyanide				NR

JRC 11/23/99

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAK91

Lab Name: SENTINEL INC. Contract: 68-D6-0001

Lab Code: SENTIN Case No.: 27338 SAS No.: SDG No.: MJAK77

Matrix (soil/water): WATER Lab Sample ID: 24776S

Level (low/med): LOW Date Received: 09/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	3030			P
7440-36-0	Antimony	3.0	U	~~N~~ J	P
7440-38-2	Arsenic	81.0			P
7440-39-3	Barium	21.1	B		P
7440-41-7	Beryllium	0.79	B		P
7440-43-9	Cadmium	177			P
7440-70-2	Calcium	255000			P
7440-47-3	Chromium	7.1	~~B~~	UJ	P
7440-48-4	Cobalt	216			P
7440-50-8	Copper	173			P
7439-89-6	Iron	158000			P
7439-92-1	Lead	664			P
7439-95-4	Magnesium	294000			P
7439-96-5	Manganese	244000			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	197			P
7440-09-7	Potassium	12000		~~E~~ J	P
7782-49-2	Selenium	46.1			P
7440-22-4	Silver	33.8			P
7440-23-5	Sodium	7450			P
7440-28-0	Thallium	91.5			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	110000			P
	Cyanide				NR

11/23/99

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MJAK92

Lab Name: SENTINEL INC. Contract: 68-D6-0001

Lab Code: SENTIN Case No.: 27338 SAS No.: SDG No.: MJAK77

Matrix (soil/water): WATER Lab Sample ID: 24777S

Level (low/med): LOW Date Received: 09/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	34.2	B	J	P
7440-36-0	Antimony	3.0	U	~~N~~J	P
7440-38-2	Arsenic	3.0	U		P
7440-39-3	Barium	66.5	B		P
7440-41-7	Beryllium	0.40	U		P
7440-43-9	Cadmium	15.9			P
7440-70-2	Calcium	18900			P
7440-47-3	Chromium	1.0	U		P
7440-48-4	Cobalt	17.7	B		P
7440-50-8	Copper	8.5	B		P
7439-89-6	Iron	2380			P
7439-92-1	Lead	517			P
7439-95-4	Magnesium	34700			P
7439-96-5	Manganese	11400			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	21.6	B		P
7440-09-7	Potassium	1210	B	EJ	P
7782-49-2	Selenium	2.3	U		P
7440-22-4	Silver	7.3	B		P
7440-23-5	Sodium	1220	B		P
7440-28-0	Thallium	3.3	U		P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	4280			P
	Cyanide				NR

4/11/23 kg

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAK93

Lab Name: SENTINEL INC. Contract: 68-D6-0001

Lab Code: SENTIN Case No.: 27338 SAS No.: SDG No.: MJAK77

Matrix (soil/water): WATER Lab Sample ID: 24778S

Level (low/med): LOW Date Received: 09/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	563			P
7440-36-0	Antimony	3.0	U	~~N~~ J	P
7440-38-2	Arsenic	7.1	B		P
7440-39-3	Barium	20.2	B		P
7440-41-7	Beryllium	0.51	B		P
7440-43-9	Cadmium	55.4			P
7440-70-2	Calcium	10900			P
7440-47-3	Chromium	1.0	U		P
7440-48-4	Cobalt	12.0	B		P
7440-50-8	Copper	24.8	B		P
7439-89-6	Iron	15800			P
7439-92-1	Lead	433			P
7439-95-4	Magnesium	16700			P
7439-96-5	Manganese	15200			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	13.6	B		P
7440-09-7	Potassium	876	B	~~E~~ J	P
7782-49-2	Selenium	2.3	U		P
7440-22-4	Silver	7.4	B		P
7440-23-5	Sodium	1550	B		P
7440-28-0	Thallium	5.1	B		P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	24600			P
_____	Cyanide				NR

AKH 11/23/99

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MJAK94

Lab Name: SENTINEL INC. Contract: 68-D6-0001

Lab Code: SENTIN Case No.: 27338 SAS No.: SDG No.: MJAK77

Matrix (soil/water): WATER Lab Sample ID: 24779S

Level (low/med): LOW Date Received: 09/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	33000			P
7440-36-0	Antimony	22.0	B	~~NJ~~	P
7440-38-2	Arsenic	1390			P
7440-39-3	Barium	3.5	B	J	P
7440-41-7	Beryllium	6.5			P
7440-43-9	Cadmium	2250			P
7440-70-2	Calcium	103000			P
7440-47-3	Chromium	5.9	~~B~~	UJ	P
7440-48-4	Cobalt	697			P
7440-50-8	Copper	2530			P
7439-89-6	Iron	787000			P
7439-92-1	Lead	725			P
7439-95-4	Magnesium	111000			P
7439-96-5	Manganese	115000			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	606			P
7440-09-7	Potassium	772	B	~~EJ~~	P
7782-49-2	Selenium	72.1			P
7440-22-4	Silver	38.3			P
7440-23-5	Sodium	67400			P
7440-28-0	Thallium	177			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	854000			P
	Cyanide				NR

dtt 11/23/99

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAK95

Lab Name: SENTINEL INC. Contract: 68-D6-0001

Lab Code: SENTIN Case No.: 27338 SAS No.: SDG No.: MJAK77

Matrix (soil/water): WATER Lab Sample ID: 24780S

Level (low/med): LOW Date Received: 09/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	2640			P
7440-36-0	Antimony	3.0	U	~~N~~ J	P
7440-38-2	Arsenic	67.7			P
7440-39-3	Barium	18.7	B		P
7440-41-7	Beryllium	0.74	B		P
7440-43-9	Cadmium	156			P
7440-70-2	Calcium	226000			P
7440-47-3	Chromium	7.0	~~B~~	UJ	P
7440-48-4	Cobalt	192			P
7440-50-8	Copper	152			P
7439-89-6	Iron	140000			P
7439-92-1	Lead	583			P
7439-95-4	Magnesium	258000			P
7439-96-5	Manganese	213000			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	174			P
7440-09-7	Potassium	10300		~~E~~ J	P
7782-49-2	Selenium	40.6			P
7440-22-4	Silver	33.5			P
7440-23-5	Sodium	6590			P
7440-28-0	Thallium	76.9			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	97400			P
	Cyanide				NR

11/23/99

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAK96

Lab Name: SENTINEL INC. Contract: 68-D6-0001

Lab Code: SENTIN Case No.: 27338 SAS No.: SDG No.: MJAK77

Matrix (soil/water): WATER Lab Sample ID: 24781S

Level (low/med): LOW Date Received: 09/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	303		J	P
7440-36-0	Antimony	3.0	U	~~N~~ J	P
7440-38-2	Arsenic	3.0	U		P
7440-39-3	Barium	8.8	B		P
7440-41-7	Beryllium	0.40	U		P
7440-43-9	Cadmium	12.9		J	P
7440-70-2	Calcium	424000			P
7440-47-3	Chromium	10.6		UJ	P
7440-48-4	Cobalt	277			P
7440-50-8	Copper	2.5	U	J	P
7439-89-6	Iron	163000			P
7439-92-1	Lead	805			P
7439-95-4	Magnesium	446000			P
7439-96-5	Manganese	381000			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	251			P
7440-09-7	Potassium	20100		~~E~~ J	P
7782-49-2	Selenium	80.5			P
7440-22-4	Silver	51.2			P
7440-23-5	Sodium	5810			P
7440-28-0	Thallium	149			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	37500			P
	Cyanide				NR

11/23/99

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments: